# WINDING APPARATUS AND FEEDING APPARATUS

## FIELD OF THE INVENTION

The present invention relates to the technique of winding a long continuous film during the preparation process of an anisotropic conductive adhesive film or an insulating adhesive film, for example, and the technique of feeding a film during the use of a roll of the film.

## PRIOR ART

Generally, an anisotropic conductive adhesive film or an insulating adhesive film is used to electrically connect electronic components such as liquid crystal panels or IC chips to each other, for example.

Such adhesive films are delivered to clients in the form of rolls obtained by winding a long continuous film prepared through certain preparation processes per a certain length around a reel member using a winding apparatus.

Recently, further longer adhesive films are desired from the client side.

However, longer adhesive films require reel members with larger diameters, which involve significant changes in design conditions of existing winding apparatus such as the arrangement of guide rollers and sensors around the reel members.

On the other hand, feeding apparatus used to drawing out adhesive films from reel members with larger diameters must also

be significantly changed on the client side in the same manner as winding apparatus on the manufacturer side.

The present invention was made to solve these technical problems with the purpose of providing a winding apparatus and a feeding apparatus adaptable to longer films with minimum design changes in existing apparatus.

**SUMMARY OF THE INVENTION**

The present invention provides a winding apparatus comprising a winding shaft on which a reel member capable of winding a given film at multiple stages can be mounted and a driving mechanism for axially moving the winding shaft on which the reel member is mounted.

According to the winding apparatus of the present invention, the diameter of the flange can be maintained even when a long film is wound, whereby design changes in existing winding apparatus can be minimized.

The winding apparatus of the present invention advantageously comprises a marking mechanism for giving an identifiable marker on the film.

According to the present invention, not only the quality of the film can be maintained by avoiding the use of kinks in the film but also a marker for getting the timing of axial shift can be given when the film is fed on the client side.

The winding apparatus of the present invention also advantageously comprises a detection mechanism for detecting the position at which the marker is to be given and a controller for

controlling the marking mechanism to operate on the basis of information from the detection mechanism.

According to the present invention, the film can be marked depending on the desired roll diameter of the film.

The present invention also provides a feeding apparatus comprising a feeding shaft on which a reel member wound a given film at multiple stages can be mounted and which can be moved in the rotational and axial directions of the reel member, a driving mechanism for giving power in the rotational and axial directions to the feeding shaft, and a detection mechanism capable of detecting a given marker on the film.

According to the feeding apparatus of the present invention, a long film can be handled without increasing the diameter of the flange, thus minimizing design changes in existing feeding apparatus and also providing the advantage that a reel member wound a film can be used for a long period without replacement.

The feeding apparatus of the present invention advantageously comprises a controller for controlling the driving mechanism to generate power at least in the axial direction on the basis of information from the detection mechanism.

According to the present invention, the film can be smoothly fed to axially move the reel member by detecting a marker on the film on the client side while unnecessary treatments of kinks can be avoided when the film is wound on the manufacturer side.

The present invention also provides a film for multistage winding formed of an adhesive film containing an adhesive applied

on a release film wherein the release film is exposed at predetermined intervals.

According to the film for multistage winding of the present invention, the length of the release film alone is controlled to prevent the adhesive from sticking to the reel member, and to limit kinks to the release film during passing over the reel member when the film is wound at multiple stages, while the timing of feeding the film can be got using exposed parts of the release film as markers when the film wound at multiple stages is fed.

The present invention also provides a method for feeding a continuous film from a roll of the film wound at multiple stages in the axial direction of a feeding shaft, comprising feeding the film of a given stage and then feeding the film of the next stage by axially moving the winding shaft.

According to the method for feeding a film of the present invention, the film can be smoothly fed from a roll of the film wound at multiple stages.

The present invention also provides a method for feeding a continuous film for multistage winding from a roll of the film wound at multiple stages, the film being formed of an adhesive film containing an adhesive applied on a release film wherein the release film is exposed at given intervals, the method comprising feeding the film of a given stage and then feeding the film of the next stage by axially moving the winding shaft on the basis of detected information of the exposed part of the release film.

According to the method for feeding a film of the present

invention, the film can be smoothly drawn out from each stage of a roll of the film wound at multiple stages without causing kinks in the adhesive film.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view showing the outline structure of a winding apparatus of the present invention, and FIG. 2 is a left side view showing the outline structure of the winding apparatus.

FIG. 3 (a) is a front view showing the outline structure of an example of a reel member used in a winding apparatus of the present invention, and FIG. 3 (b) is a right side view showing the outline structure of the reel member.

FIG. 4 (a) to FIG. 9 (a) are left side views showing how a film is wound around a reel member used in the present invention, and FIG. 4 (b) to FIG. 9 (b) are front views showing how the film is wound.

FIG. 10 (a) is a left side view showing a reel member used in the present invention around which a film has been wound, and FIG. 10 (b) is a front view showing the reel member around which a film has been wound.

FIG. 11 is a left side view showing the outline structure of an affixing system incorporating a feeding apparatus of the present invention.

FIG. 12 (a) is a left side view showing how a film is fed from a reel package used in the present invention, and FIG. 12 (b) is a front view showing how a film is fed from the reel package.

In these drawings, various numeral references represent the following elements: 10, winding apparatus; 20, feeding apparatus; 21, feeding shaft; 31, winding shaft; 26, 40, driving mechanism; 22, 42, first driving mechanism; 24, 44, second driving mechanism; 42d, 42e, 29, detection mechanism; 50, reel member; 60, 60A, controller; 70, adhesive-stripping mechanism (marking mechanism).

**THE MOST PREFERRED EMBODIMENTS OF THE INVENTION**

Winding apparatus of the present invention is used to wind a continuous long film at multiple stages.

Films used in the present invention are advantageously, but not limited to, insulating adhesive films or anisotropic conductive adhesive films, especially for electrically connecting electrodes of circuit boards to electrodes of IC chips.

Insulating adhesive films here comprise an insulating adhesive formed as a film on a release film. Anisotropic conductive adhesive films mean films comprising said adhesive containing conductive particles.

Preferred embodiments of reel members capable of winding such insulating adhesive films and anisotropic conductive adhesive films (hereinafter sometimes referred to as simply "films") are explained below with reference to the attached drawings.

In the films used in the following embodiments, the adhesive is removed at predetermined intervals to partially expose the release film.

A preferred embodiment of a winding apparatus of the present

invention is explained in detail below with reference to the attached drawings.

FIG. 1 is a front view showing the outline structure of a winding apparatus of the present invention, and FIG. 2 is a left side view showing the outline structure of the winding apparatus.

As shown in FIG. 1 or FIG. 2, winding apparatus 10, according to the present embodiment, comprises a winding shaft 31, a driving mechanism 40 and a controller 60.

A winding shaft 31 is intended to be mounted a given reel member described below and provided in parallel to a feeding shaft (not shown in drawings) on the feeding side of film 2. This winding shaft 31 is supported by bearing members 31a at both ends so that it can be moved in both radial and axial directions.

An example of the reel member that can be mounted on winding shaft 31 is shown below.

FIG. 3 (a) is a front view showing the outline structure of an example of a reel member used in a winding apparatus of the present invention, and FIG. 3 (b) is a right side view showing the outline structure of the reel member.

As shown in FIGs. 3 (a) and (b), a reel member 50 used in the present embodiment is integrally formed from a resin, for example, and comprises a winding spool 52 and a plurality of flanges 51.

These flanges 51 are formed as discs having a predetermined outer diameter and arranged in parallel to each other at predetermined intervals on cylindrical winding spool 52.

The outer diameter of flange 51 is determined to be greater

than the maximum roll diameter d of film 2 for the purpose of protecting a roll of film 2. The maximum roll diameter d here is selected depending on the length of film 2 so that the adhesive cannot be squeezed out of the end face of the roll under the stress generated during winding.

The number of flanges 51 is selected depending on the maximum roll diameter d and the length of the film to be contained in reel member 50, and the interval between flanges 51 is selected to be somewhat greater than the width of the film (e.g., 1.9 mm).

As shown in FIG. 3 (b), each flange 51 has a guide groove 53 of the same shape for passing the film to another flange 51 adjacent thereto.

Guide grooves 53 are each cut away in an approximately sectorial shape to only partially expose the rolled film and are axially aligned in opposite to guide grooves 53 adjacent thereto.

Thus, a guide edge 54 formed on the outer periphery of each guide groove 53 comes into contact with the film at the same position as the other guide edges 54 in the circumferential direction of flange 51.

Winding spool 52 is formed in a length depending on the number of flanges 51 or the interval therebetween. Winding spool 52 has an axially running through-hole 55 having a cross section substantially in the form of a letter of "D".

As shown in FIG. 1, winding shaft 31 is designed to be fitted into through-hole 55 in reel member 50 with a slight gap, thereby supporting reel member 50 in such a manner that it can be axially

moved while it is fixed against circumferential movement.

Reel member 50 is blocked from axial movement by a pair of pins 31b on winding shaft 31, whereby each winding spool 52 is positioned in relation to film 2 on the feeding side.

As shown in FIG. 1, driving mechanism 40 comprises a first driving mechanism 42 for giving power in the rotational direction to winding shaft 31, and a second driving mechanism 44 for giving power in the axial direction to winding shaft 31.

First driving mechanism 42 is designed to transmit the power of a winding motor 42c, consisting of a stepping motor, to a gear 42a fixed to winding shaft 31 via a given train of gears 42b to rotate winding shaft 31.

An encoder 42d having a plurality of slits is fixed to winding motor 42c as a detection mechanism and a light reflective sensor 42e capable of detecting encoder 42d is also provided.

Such winding motor 42c and sensor 42e are electrically connected to controller 60 respectively. Controller 60 is designed to count the number of pulses of winding motor 42c on the basis of signals from sensor 42e and to control the rotation of winding motor 42c on the basis of the number of pulses.

Second driving mechanism 44 is designed to transmit the power of a slide motor 44c, consisting of a stepping motor, to a gear 44a engaging with a rack 43a, provided at a part of a casing 43 containing first driving mechanism 42, via a given train of gears 44b to slide the rotational shaft 31 in cooperation with first driving mechanism 42 while casing 43 is fixed on winding shaft 31.

This slide motor 44c is electrically connected to controller 60 so that it is controlled to operate for a time corresponding to a given number of pulses.

As shown in FIG. 2, winding apparatus 10, according to the present embodiment, comprises an adhesive-stripping mechanism 70 as an example of a marking mechanism.

This adhesive-stripping mechanism 70 is provided between a first position P1 and a second position P2 on the transporting path of film 2, and designed to strip the adhesive from film 2, transported from the feeding side with a scraper 71, and to feed release film 2b alone to the winding side.

Adhesive-stripping mechanism 70 is electrically connected to controller 60 so that it is controlled to operate in accordance with a predetermined sequence.

When film 2 should be divided herein, the part bearing an adhesive is designated as "adhesive film 2a" while the part bearing no adhesive is designated as "release film 2b".

The first position P1, defined as the start position of release film 2b or the end position of adhesive film 2a (shown in Fig 5a), is determined depending on the maximum roll diameter d of reel member 50.

The distance between the first position P1 and the second position P2, i.e., the exposed length of release film 2b, is determined within a minimum range necessary for passing the film over flange 51 in order to prevent the adhesive from sticking to flange 51 and save the adhesive when the film is passed over reel member 50.

Release film 2b alone without adhesive on film 2 serves as a marker of a part having passed over reel member 50 in a feeding apparatus 20 described below.

The second position P2, defined as the end position of release film 2b or the start position of the next adhesive film 2a, is determined at a length that allows the second position P2 to be detected in feeding apparatus 20 at the stage when the first position P1 of release film 2b arrives on winding spool 52, around which adhesive film 2a has been wound in order to limit kinks to release film 2b when the film is passed over reel member 50.

How a film is wound according to the present embodiment having the structure described above is explained with reference to the attached drawings.

FIG. 4 (a) to FIG. 9 (a) are left side views showing how a film is wound around a reel member used in the present invention, and FIG. 4 (b) to FIG. 9 (b) are front views showing how the film is wound.

In the following description, flanges 51 of reel member 50 are designated as "first flange 51a", "second flange 51b", "third flange 51c" and "fourth flange 51d" successively from the rightmost one, and winding spools 52 of reel member 50 are designated as "first winding spool 52a" between first and second flanges 51a and 51b, "second winding spool 52b" between second and third flanges 51b and 51c, and "third winding spool 52c" between third and fourth flanges 51c and 51d, as shown in FIG. 1, for convenience of explanation.

In the present embodiment, reel member 50 is first mounted on winding shaft 31 and positioned in such a manner that film 2 on the feeding side is evenly supported between first and second flanges 51a and 51b, as shown in FIGs. 4 (a) and (b).

Then, the leading end of film 2 on the feeding side is manually wound around first winding spool 52a of reel member 50 on the winding side.

Under a command from controller 60 described above, winding motor 42C is activated to start the rotation of winding shaft 31 and also start to count the number of pulses of winding motor 42C.

Thus, film 2 is wound around first winding spool 52a while it is being drawn from the feeding side by reel member 50 (see FIGs. 4 (a), (b)).

Controller 60 generates a command to activate adhesive-stripping mechanism 70 when it judges from the number of pulses of winding motor 42c that the diameter of film 2 wound around first winding spool 52a reaches the maximum roll diameter d (see FIG. 2). Thus, adhesive-stripping mechanism 70 strips the adhesive from film 2, along a predetermined length, from the first position P1 to the second position P2.

When controller 60 judges from the number of pulses of winding motor 42c that the leading end (first position P1) of release film 2b is on the position of passing through guide groove 53 in second flange 51b while first winding spool 52a of reel member 50 is finishing to wind the part of adhesive film 2a as shown in FIGs. 5 (a) and (b), it stops the operation of winding motor 42c.

At this point, slide motor 44c is operated for a time corresponding to a given number of pulses to axially (in the direction of arrow in FIG. 6 (b)) slide winding shaft 31, as shown in FIGs. 6 (a) and (b), under a command from controller 60. Thus, reel member 50 moves with winding shaft 31 so that release film 2b on the feeding side comes to a twisted position with respect to film 2 on first winding spool 52a. Release film 2b runs off guide groove 53 of second flange 51b to approach third flange 51c.

When reel member 50 is rotated again in this state, second flange 51b catches release film 2b at guide edge 54, as shown in FIGs. 7 (a) and (b).

As reel member 50 rotates, it then winds release film 2b around second winding spool 52b while it is caught by second flange 51b, and it further rotates to wind adhesive film 2a upstream of the rear end (second position P2) of release film 2b, as shown in FIG. 8.

On the other hand, slide motor 44c is operated under a command from controller 60 so that reel member 50 is moved in the direction of the arrow in FIG. 8 (b) and returned to the position in which film 2 on the feeding side is evenly supported between second and third flanges 51b and 51c, as shown in FIG. 8 (b) and FIG. 9 (b).

Then, the winding operation as described above is repeated for third winding spool 52c of reel member 50.

FIG. 10 (a) is a left side view showing a reel member used in the present invention around which a film has been wound, and FIG. 10 (b) is a front view showing the reel member around which

a film has been wound.

A film package 50A is obtained in which adhesive film 2a is wound around each winding spool 52 successively from first winding spool 52a to third winding spool 52c with exposed parts of release film 2b being passed from flanges 51 to winding spools 52, as shown in FIGs. 10 (a) and (b), by applying the winding operation described above.

Next, a preferred embodiment of a feeding apparatus according to the present invention is explained below referring to an affixing system as an example.

FIG. 11 is a left side view showing the outline structure of an affixing system incorporating a feeding apparatus of the present invention.

As shown in FIG. 11, the affixing system 1, according to the present embodiment, is intended to affix adhesive film 2a at a given position on, e.g., a circuit board, and comprises a feeding apparatus 20, a pressure head 80 and a winding mechanism 90.

Feeding apparatus 20 comprises a feeding shaft 21, a driving mechanism 26 consisting of a first and a second driving mechanisms 22, 24 and a controller 60A, and is designed to feed a continuous film 2 from film package 50A approximately in the same manner as winding apparatus 10 described above.

In the case of the present embodiment, feeding apparatus 20 comprises a film sensor (detection mechanism) 29 in the structure.

This film sensor 29 is a light reflective sensor located in the proximity of feeding apparatus 20 where the adhesive side of

film 2 can be detected. Film sensor 29 is electrically connected to controller 60A. This controller 60A is designed to control the power of feeding motor 22c and slide motor 44c contained in first and second driving mechanisms 22, 24, respectively, on the basis of signals from film sensor 29.

Pressure head 80 is designed to apply heat and pressure to film 2 transported on a given path via guide rollers 3 from feeding apparatus 20. This pressure head 80 is electrically connected to controller 60A, whereby the operation of pressure head 80 itself is controlled by a driving mechanism not shown on the basis of signals from film sensor 29.

Winding mechanism 90 is designed to give a rotating power to the spool around which film 2 is to be wound.

How a film is fed in the present embodiment having such a structure is explained with reference to the attached drawings.

FIG. 12 (a) is a left side view showing how a film is fed from a reel package used in the present invention, and FIG. 12 (b) is a front view showing how a film is fed from the reel package.

In the case of the present embodiment, the behavior of film 2, fed from reel package 50A by feeding apparatus 20, is reverse to the that of film 2 wound by winding apparatus 10, i.e., film 2 is first fed on a path including pressure head 80 from third winding spool 52c of reel package 50A as feeding shaft 21 rotates.

When film sensor 29 detects the leading end (second position P2) of release film 2b, bounded by adhesive film 2a, after third winding spool 52c (see Fig. 8(b)) of reel package 50A has completed

feeding of adhesive film 2a, as shown in FIGs. 12 (a), (b), controller 60A commands feeding motor 22c to stop at such a timing that release film 2b passes through guide groove 53 of third flange 51c on the basis of signals from film sensor 29, and then activates slide motor 44c to slide feeding shaft 21 in the direction of the arrow shown in FIG. 12 (b).

In this case, the rear end (first position P1) of release film 2b is situated on adhesive film 2a in the roll so that film 2, drawn out by sliding reel package 50A, is exposed release film 2b and no kinks occur in adhesive film 2a during such drawing out.

Then, feeding shaft 21 is rotated again to feed film 2 on the path including pressure head 80 from second winding spool 52b of reel package 50A. Subsequently, the operation described above is repeated to transfer film 2 from second winding spool 52b to first winding spool 52a.

Thus, adhesive film 2a fed from feeding apparatus 20 is affixed under pressure by operating pressure head 80 at a given timing as shown in FIG. 11, and at the same time, release film 2b is sequentially wound by winding mechanism 90.

According to the present embodiment as described above, reel member 50 (including reel package 50A) is mounted and rotated and axially moved at the same time so that a continuous film 2 can be wound at multiple stages, or a film 2 can be continuously fed from a multistage roll of film 2, whereby a long film 2 can be handled without increasing the diameter of flange 51, and accordingly, design changes in existing winding apparatus or feeding apparatus can be

minimized.

Especially, feeding apparatus 20 has the advantage that reel member 50 containing film 2 can be used for a long period without replacement.

According to the present embodiment, the adhesive is stripped from regions of film 2 necessary to be passed over flanges 51 to differentiate these regions from adhesive regions so that not only the quality of film 2 can be maintained by avoiding the use of kinks on the client side when film 2 is wound, but also markers for getting the timing of axial shift can be given when film 2 is fed on the client side.

Moreover, the length of release film 2b is determined depending on the necessary length to be passed over reel member 50, thereby preventing the adhesive on film 2 from sticking to flanges 51.

On the client side, regions formed of release film 2b alone are detected as markers (second position P2) so that film 2 can be smoothly fed and unnecessary treatments of the non-adhesive regions can be avoided.

The present invention is not limited to the foregoing embodiments, but may include various modifications.

For example, adhesive-stripping mechanism 70 used for stripping the adhesive at predetermined intervals in the foregoing embodiment will be unnecessary in the present invention if a film comparable to those treated in adhesive-stripping mechanism 70 is prepared without forming an adhesive on release film 2b, at a timing similar to the timing used in adhesive-stripping mechanism 70, in

the step of forming an adhesive on release film 2b, or if the step of partially forming non-adhesive regions and the winding step of the present invention are simultaneously performed.

In the present invention, a film for multistage winding formed by joining adhesive films 2a, each having a length corresponding to a roll with, e.g., a soft material, can also be used. In this case, the soft material serves as a marker at junctions to adhesive films (first and second positions) and a material softer than release film 2b is advantageously selected for passing the film.

The marking mechanism of the present invention is not limited to adhesive-stripping mechanism 70 according to the above embodiment, but other mechanisms capable of giving markers identifiable by known detection techniques such as printing mechanisms or punching machines can also be applied. Then, a detection mechanism can be provided on the side of feeding apparatus 20 depending on the markers given by the marking mechanism.

In this case, markers are scatteredly or continuously given so that the part of film 2 having been passed can be identified on the side of feeding apparatus 20 in the same manner as in the above embodiment, and at least the leading end of the part of film 2 having been passed (second position in the above embodiment) should be marked when such a part is fed.

The present invention is not limited to the embodiment in which feeding apparatus 20 of the present invention is incorporated into an affixing system 1, as shown above, but it may also be applied to a system in which a continuous film 2 must be continuously fed.

Reel member 50 in the embodiment above is shown only as an example, but the reel member used in winding apparatus 10 or feeding apparatus 20 of the present invention is not specifically limited so far as it satisfies such a condition that it can be mounted to both apparatus and can pass a film to an adjacent winding spool 52 with a flange 51 interposed therebetween.

A structure in which such reel member 50 and winding shaft 31 according to the above embodiment are combined can also be used, in which case the reel member combined with winding shaft 31 should be detachable from winding apparatus 10 and subjected to power in the rotational and axial directions when it is mounted on winding apparatus 10. This also applies to feeding apparatus 20.

Although winding shaft 31 itself moves in the rotational and axial directions while reel member 50 is fixed to winding shaft 31 in the above embodiment, the present invention can also include a structure wherein winding shaft 31 is rotated and reel member 50 is slid on winding shaft 31 while reel member 50 is supported on winding shaft 31 movably only in the axial direction.

Although driving mechanism 26 of feeding apparatus 20 is designed to give power to feeding shaft 21 in both rotational and axial directions using a motor in the above embodiment, a resilient member such as a spring may be used to apply a tension on film 2 from the side of winding mechanism 90 because power in the rotational direction is given from the side of winding mechanism 90.

In this case, however, independent power should preferably be given from separate motors in both rotational and axial directions

of feeding shaft 21, as in the above embodiment, because the behavior of film 2 may be slowed down even if the power on the side of winding mechanism 90 is controlled as in the above embodiment and the tension generated in film 2 on pressure head 80 may be unstable.

**INDUSTRIAL APPLICABILITY**

As described above, the present invention provides winding apparatus and feeding apparatus adaptable to long films with minimum design changes in existing apparatus.